Nonstandard inverse problems in micro-macro mechanics

By T. I. Zohdi

Department of Mechanical Engineering, 6195 Etcheverry Hall, University of California, Berkeley, CA, 94720-1740, USA

The focus of this work is to highlight some nonstandard inverse problems in micro-macro mechanics. Three objectives are addressed: 1) To design materials composed of randomly dispersed particulates suspended in a homogeneous binding matrix, where the objectives are to deliver prescribed macroscopic effective responses while simultaneously obeying constraints that reflect the distortion of the microscale stress fields, as well as the likelyhood for fatigue damage, 2) To design "swarming fluid materials", where the overall goal is to design autonomous self-correcting particulate groups whose goal is to reach a target guarded by obstacles in a minimum amount of time and 3) To determine the ambient conditions under which flowing grains of interstellar dust in a gaseous, hydrogen-rich, atmosphere, can fuse, due to the high strain rates during binary particle impacts, coupled with thermochemical reactions. All of the mentioned are treated with a nonconvex optimization strategy, based on a nonderivative statistical genetic algorithm.

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